REMARKS

This response addresses the issues raised by the Examiner in the Office Action mailed June 8, 2004. Initially, Applicants would like to thank the Examiner for the careful consideration given in this case. The Claims were 1-14. Claim 1 has been currently amended and Claims 4-5 have been canceled. Thus, Claims 1-3 and 6-14 are pending in this case all to more clearly and distinctly claim Applicants' invention. Applicants respectfully request entry of the amendments as they place the application in condition for allowance or in better condition for possible appeal.

Claim 1 has been amended to add a process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration (CVI) where methyltrichlorosilane (MTS) in hydrogen (H_2) as carrier gas is used for silicon carbide deposition and the partial pressure ratio of hydrogen to methyltrichlorosilane is adjusted between 4 and 8. Support is found in the specification and claims as originally filed. No new matter has been added.

Rejection Based On 35 U.S.C. § 112, First Paragraph

The Examiner rejects Claims 1-14 under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. The Examiner argues that the claims contain subject matter that was not described in the specification in such a way as to reasonable convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention. More specifically, the Examiner asserts that the specification does not have adequate support for the claimed temperature range of "greater than 1000 degrees Celsius". Applicants respectfully traverse this rejection.

Applicants respectfully disagree with the Examiner. The specification clearly describes that the process temperature of greater than 1100 °C is used in the present invention. The phrase "≦ 1100 °C" was used throughout the specification, and it clearly means both greater and equal to 1100 °C. See Abstract and Specification at paragraphs [0012] and [0013]. In addition, a temperature of 1150 °C is mention in an example in

paragraph [0039]. It is respectfully submitted that the disclosure fully supports Claims 1-14. Therefore, Applicants respectfully request withdrawal of the rejection under 35 U.S.C. § 112, second paragraph.

Rejection Based On Huttinger Under 35 U.S.C. § 103 (a)

The Examiner rejects Claims 1-9, 13 and 14 under 35 U.S.C. § 103 (a) as being unpatentable over WO 98/21163 to Huttinger et al. as applied to currently amended Claim 1. Applicants respectfully traverse this rejection.

The Examiner argues that Huttinger teaches a CVI process for depositing SiC into a preform. Also, the Examiner asserts that the precursor, carrier gas, hydrogen or hydrogen chloride is taught in Huttinger. In addition, the Examiner asserts that Huttinger discloses pressures and porosity in Applicants' range. While the Examiner concedes that Huttinger fails to teach a process temperature of greater than 1100 °C , the Examiner argues that it would have been obvious at the time the invention was made to a person of ordinary skill in the art to use temperatures with the Applicants' range in the process taught by Huttinger. Further, the Examiner state that differences in temperature will not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such concentration of temperature is critical. Thus, the Examiner concludes that Applicants have not shown the criticality between 1100 °C and 1100.01 °C.

To establish obviousness of a claimed invention, all claim elements must be disclosed, taught or suggested by the prior art. As stated above, Claim 1 has been amended to add a process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration where methyltrichlorosilane in hydrogen as carrier gas is used for silicon carbide deposition and the partial pressure ratio of hydrogen to methyltrichlorosilane is adjusted between 4 and 8.

We agree with the Examiner that Huttinger does not teach a process temperature of greater than 1100 ^{O}C. Huttinger teaches a method for chemical vapor infiltration of carbon and silicon carbide based on diffusion in a porous structure and functions isothermally. See Abstract and Specification at Col. 2 and 3, lines 65-68 and lines 1-2, respectively. It has been known in the art to use methyltrichlorosilane as a precursor in hydrogen for infiltration with silicon carbide. However, this is mentioned generally in Huttinger with no details given for the physical conditions, such as temperature, pressure, mole fraction and partial pressures. These physical conditions are indispensable for defining a deposition process. The interaction of these process features decides the nature and properties of the deposition product. Further, Huttinger teaches that the methyltrichlorosilane is not suitable for vapor infiltration because of decomposition reactions. See Col. 4, lines 38-44. Huttinger prefers using $SiCl_4$ and CH_4 for vapor infiltration. See Col. 4, lines 48-52.

Further, the process gas pressure disclosed in Huttinger describes a gaseous phase of methane with which only carbon can be disposed in embodiment 3 and a gaseous phase containing MTS and HCl in embodiment 8. This is unlike the present invention. The present invention is not concerned with carbon deposition and the mixture of MTS and HCl is not even mentioned in the specification of the present invention. Also, Huttinger teaches a process using the temperature range of 900 to 1100 ^{O}C, which is below the temperature range of the present invention.

Moreover, the Examiner refers to Huttinger for teaching that the carrier gas, hydrogen or hydrogen chloride is taught within the Applicants' range. However, there Huttinger is describing a gas mixture for SiC deposition containing a dosed amount of hydrogen chloride. Hydrogen chloride is not adding to the process gas of the present invention because an addition of hydrogen chloride would impede that deposition of SiC with the consequence of co-deposition of carbon and the forming of low stability undesired structures.

The present invention claims a process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration with a silicon carbide precursor in a

suitable carrier gas on carbon fiber preforms or silicon carbide fiber preforms. Here, methyltrichlorosilane in hydrogen as the carrier gas is used for silicon carbide deposition and the partial pressure ratio of hydrogen to methyltrichlorosilane is adjusted between 4 and 8. The present invention further comprising adjusting the process pressure to $\geq$ 0.6 bar absolute and adjusting the process temperature to greater than 1100 °C. See Paragraph [0012]. A process temperature of 1200 °C and 1150 °C is used in example 1 and example 3, respectively. This process temperature exceed Huttinger's process from 50 to 100 °C. The higher temperature is used because a better SiC structure can be achieved without co-deposition of free silicon. The combination of the process parameters of the present invention provides very good infiltration results with shortened processing time that is more economical. See Paragraph [0011]. This good infiltration result is surprisingly achieved despite the marked increased deposition rate in the combination of process parameters in the present invention. See Paragraph [0014].

In addition, even if Huttinger where to use the process temperature of the present invention, the exponential increase of the reaction velocity with the temperature in connection with gas phase infiltration may prevent a desirable deposition. This is because the desirable deposition also depends from the pore structure and size. Pore structure and size depends on the fiber used and the type of binding used. Thus, the process temperature, pore structure and pore size contribute to an admissible reaction velocity to avoid a quick closure of the access way into the interior of the fiber preform.

While it is desirable from an economic standpoint to choose a high temperature to shorten the process time, the interplay is bound to a defined reaction system. Thus, the carbon deposition from methane to SiC deposition from MTS are not comparable to each other. In other words, carbon deposition from methane in Huttinger shows a different effect with respect to reaction velocity and thus deposition velocity than in MTS/SiC system. The product properties are strongly dependent on the interplay of specific process parameters. In

the present invention, the specific process parameters are the specific MTS/H_2 ratio range and the combination of temperature and process gas pressure.

Accordingly, Huttinger does not teach a process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration where methyltrichlorosilane in hydrogen as carrier gas is used for silicon carbide deposition and the partial pressure ratio of hydrogen to methyltrichlorosilane is adjusted between 4 and 8. Furthermore, Huttinger does not teach the process temperature of greater than 1100 °C. Thus, the Applicants believe that the present invention is not obvious over the teaching of Huttinger since Huttinger does not teach, disclose or suggest the present claims. Therefore, Applicants respectfully request reconsideration and withdrawal of the rejection under 35 U.S.C. § 103 (a).

Rejection Based On Huttinger In View of Murphy Under 35 U.S.C. § 103 (a)

The Examiner rejects Claims 10-12 under 35 U.S.C. § 103 (a) as being unpatentable over WO 98/21163 to Huttinger et al. in view of U.S. Patent No. 4,407,885 to Murphy et al. as applied to currently amended Claim 1. Applicants respectfully traverse this rejection.

The Examiner acknowledges that Huttinger does not teach how the preform is made. Instead, the Examiner cites to Murphy for teaching a method of forming preforms. Thus, the Examiner concludes that it would have been obvious at the time the invention was made to a person of ordinary skill in the art to use the method taught by Murphy to construct the preforms in the process taught by Huttinger and have a reasonable expectation of success.

Applicant respectfully disagrees with the Examiner. To establish obviousness of a claimed invention, all claim elements must be disclosed, taught or suggested by the prior art. As stated above, Claim 1 has been currently amended to include a process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration where

methyltrichlorosilane in hydrogen as carrier gas is used for silicon carbide deposition and the partial pressure ratio of hydrogen to methyltrichlorosilane is adjusted between 4 and 8.

Applicants agree with the Examiner that Huttinger does not teach how the preform is made. Also, Huttinger does not teach that in a process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration where methyltrichlorosilane in hydrogen as carrier gas is used for silicon carbide deposition and the partial pressure ratio of hydrogen to methyltrichlorosilane is adjusted between 4 and 8. Further, Huttinger does not teach using the process temperature that is greater than 1100 °C.

Although Murphy discloses a method of making a composite fabric preform, Murphy does not teach that in a process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration where methyltrichlorosilane in hydrogen as carrier gas is used for silicon carbide deposition and the partial pressure ratio of hydrogen to methyltrichlorosilane is adjusted between 4 and 8 at a process temperature of greater than 1100 °C.

The present invention claims a process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration with a silicon carbide precursor in a suitable carrier gas on carbon fiber preforms or silicon carbide fiber preforms. Here, methyltrichlorosilane in hydrogen as the carrier gas is used for silicon carbide deposition and the partial pressure ratio of hydrogen to methyltrichlorosilane is adjusted between 4 and 8. The present invention further comprising adjusting the process pressure to $\geq$ 0.6 bar absolute and of adjusting the process temperature to greater than 1100 °C.

Accordingly, Huttinger does not teach how the preform is made and the use of the process temperature that is greater than 1100 °C. Also, Murphy does not cure this deficiency of Huttinger. Thus, Applicants believe that the amended invention is not obvious over the teaching of Huttinger further in view of Murphy since Huttinger and/or Murphy does not teach, disclose or suggest the present claims. Moreover, one skilled in the art would find

nothing in Huttinger or Murphy alone or in combination that would disclose, teach or suggest the claimed invention or any reason for making it. Further, there is no motivation to combine the references in such a way to get the claimed invention. Therefore, an obvious rejection under 35 U.S.C. §103 (a) is improper.

Rejection Based On Huttinger In View of Linn Under 35 U.S.C. § 103 (a)

The Examiner rejects Claims 1-9, 13 and 14 under 35 U.S.C. § 103 (a) as being unpatentable over WO 98/21163 to Huttinger et al. in view of U.S. Patent No. U.S. 6,143,376 to Linn et al. Applicants respectfully traverse this rejection.

The Examiner acknowledges that Huttinger does not teach a process temperature of greater than 1100 °C. Instead, the Examiner asserts that Linn discloses using 1200 °C as the process temperature. Thus, the Examiner concludes that it would have been obvious at the time the invention was made to a person of ordinary skill in the art to utilize 1200 °C as the process temperature in Huttinger and have a reasonable expectation of success.

Applicant respectfully disagrees with the Examiner. To establish obviousness of a claimed invention, all claim elements must be disclosed, taught or suggested by the prior art. As stated above, Claim 1 has been currently amended to include a process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration where methyltrichlorosilane in hydrogen as carrier gas is used for silicon carbide deposition and the partial pressure ratio of hydrogen to methyltrichlorosilane is adjusted between 4 and 8.

Applicants agree with the Examiner that Huttinger does not teach a process temperature of greater than 1100 °C. In addition, Huttinger does not teach that in a process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration where methyltrichlorosilane in hydrogen as carrier gas is used for silicon carbide

deposition and the partial pressure ratio of hydrogen to methyltrichlorosilane is adjusted between 4 and 8.

In regards to Linn, Linn teaches a method for coating individualized short fibers with freely accessible surfaces. It has been known in the art that the coating of free surfaces allows for process conditions, resulting in a high deposition rate, i.e. high temperature, high partial pressure, low partial pressure of reaction gases and high gas stream. However, the infiltration of narrow pore spaced and thick-wall fiber bodies according to the prior art made process conditions necessary, requiring low deposition rates, i.e. low temperature, low pressure and low gas stream. Linn also teaches that thin coatings on the short fiber are 15 nanometers thick which is deposited on freely accessible surfaces of the short fibers. Linn discloses a deposition temperature of 1200 °C is combined with a dilution of the precursor MTS in H_2 in a ratio of 1:8. This is unlike the present invention, where the process is carried out at 1200 °C with a considerably higher MTS/H_2 ratio of 1:4 and thus a deep infiltration into complex long fiber fabric structures is achieved under deposition of SiC in a thickness range of 100 μm, providing for the stressable bridging of the fiber bundles necessary for load transmission. The difference by a factor in the range of 10000 elucidates the differences in Linn and the present invention.

In the present invention, it has been surprisingly found that process temperatures above 1100 °C and at high partial pressure of the precursor for the material to be deposited, here MTS, result in a matrix infinity. This is a surprise because deep infiltration with high deposition rates was deemed to be impossible due to current experimental observations and process models derive therefrom. As a result, Huttinger does not teach a process temperature of greater than 1100 ^{O}C. Also, Linn does not teach a process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration with a silicon carbide precursor in a suitable carrier gas on fiber scrims of carbon fiber preforms or silicon carbide fiber preforms, where methyltrichlorosilane in hydrogen as carrier gas is used for silicon carbide deposition and the partial pressure ratio of hydrogen to methyltrichlorosilane

is adjusted between 4 and 8. Thus, Applicants believe that the amended invention is not obvious over the teaching of Huttinger further in view of Linn since Huttinger and/or Linn does not teach, disclose or suggest the present claims. Moreover, one skilled in the art would find nothing in Huttinger or Linn alone or in combination that would disclose, teach or suggest the claimed invention or any reason for making it. Further, there is no motivation to combine the references in such a way to get the claimed invention. Therefore, an obvious rejection under 35 U.S.C. §103 (a) is improper.

Rejection Based On Huttinger In View of Linn And Further In View of Murphy Under 35 U.S.C. § 103 (a)

The Examiner rejects Claims 10-12 under 35 U.S.C. § 103 (a) as being unpatentable over WO 98/21163 to Huttinger et al. in view of U.S. Patent No. U.S. 6,143,376 to Linn et al., as applied to Claim 1 above, and further in view of U.S. Patent No. 4,407,885 to Murphy et al. as applied to currently amended Claim 1. Applicants respectfully traverse this rejection.

The Examiner concedes that Huttinger in view of Linn is silent in teaching how the preform in made. Instead, the Examiner asserts that Murphy teaches a method of forming preforms that read of Applicants' method. Thus, the Examiner concludes that it would have been obvious at the time the invention was made to a person of ordinary skill in the art to use the method of Murphy to construct the preforms in the process taught by Huttinger in view of Linn and have a reasonable expectation of success.

Applicant respectfully disagrees with the Examiner. To establish obviousness of a claimed invention, all claim elements must be disclosed, taught or suggested by the prior art. As stated above Claim 1, has been currently amended to include a process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration where methyltrichlorosilane in hydrogen as carrier gas is used for silicon carbide deposition and the partial pressure ratio of hydrogen to methyltrichlorosilane is adjusted between 4 and 8.

Applicants agree with the Examiner that Huttinger and Linn do not teach how the preform are made. In addition, Huttinger and Linn do not teach that in a process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration where methyltrichlorosilane in hydrogen as carrier gas is used for silicon carbide deposition and the partial pressure ratio of hydrogen to methyltrichlorosilane is adjusted between 4 and 8 at a process temperature greater than 1100 ^{O}C.

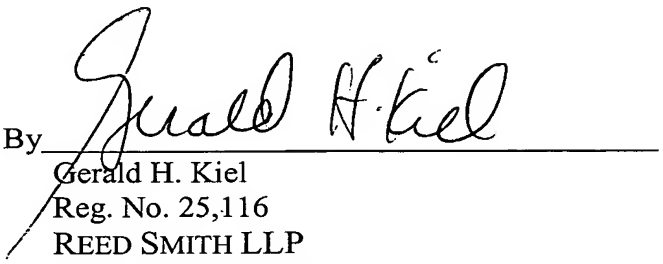
Murphy teaches a method of making a composite fabric preform where a plurality of layers of fabric are disposed in a stacked assembly with layer adjacent to each other. See Abstract. Murphy teaches that composite fabrics that are resin impregnated are well known in the art. See Col. 13, lines 18-21. However, the binding with a resin has a different meaning in the present invention. In the present invention, the fiber layers are fixed by holding devices provided with gas inlets. Here, there is a danger that the device grows together with the preform. This is cause by the specific process conditions of the process. Further, Murphy does not teach that in a process for producing a high temperature stable fiber composite ceramic by chemical vapor infiltration where methyltrichlorosilane in hydrogen as carrier gas is used for silicon carbide deposition and the partial pressure ratio of hydrogen to methyltrichlorosilane is adjusted between 4 and 8 at a process temperature of greater than 1100 °C.

Thus, Applicants believe that the amended invention is not obvious over the teaching of Huttinger in view of Linn and further in view of Murphy since Huttinger, Linn and/or Murphy does not teach, disclose or suggest the present claims. Moreover, one skilled in the art would find nothing in Huttinger, Linn or Murphy alone or in combination that would disclose, teach or suggest the claimed invention or any reason for making it. Further, there is no motivation to combine the references in such a way to get the claimed invention. Therefore, an obvious rejection under 35 U.S.C. §103 (a) is improper.

In view of the remarks presented herein, it is respectfully submitted that the present application is in condition for final allowance and notice to such effect is requested. If the Examiner believes that additional issues need to be resolved before this application can be passed to issue, the undersigned invites the Examiner to contact him at the telephone number provided below.

Respectfully submitted,

Dated: September 8, 2004

By 

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